Citation:

van der Heijden AA, Hu FB, Rimm EB, van Dam RM. A prospective study of breakfast consumption and weight gain among US men. *Obesity* (Silver Spring). 2007 Oct; 15(10): 2,463-2,469.

PubMed ID: 17925472

Study Design:

Sub-analysis of the Health Professional Follow-up Study, which was a prospective cohort study

Class:

B - Click here for explanation of classification scheme.

Research Design and Implementation Rating:

POSITIVE: See Research Design and Implementation Criteria Checklist below.

Research Purpose:

To investigate the association between breakfast consumption and weight gain in an adult male population over a 10-year period.

Inclusion Criteria:

- Participant in the Health Professional Follow-up Study
- US male
- Health professional
- Age 40 to 75 years.

Exclusion Criteria:

- Those with missing values for breakfast consumption
- Those with missing values for body mass index (BMI)
- Men with implausibly low (less than 800kcal per day) or high (more than 4,200kcal per day) total energy intake
- Men with more than 70 blank items on the food frequency questionnaire (FFQ)
- Men with history of diabetes, cardiovascular disease and cancer (except non-melanoma skin cancer).

Description of Study Protocol:

Recruitment

Participant data from the Health Professional Follow-up Study.

Design

- Prospective cohort study
- Information on lifestyle factors and health status obtained using biennially mailed questionnaires
- Dietary data assessed every four years.

Dietary Intake/Dietary Assessment Methodology

Semi-quantitative FFQs validated previously among a subset of participants against two one-week dietary records.

Statistical Analysis

- Age-adjusted and multivariate linear regression analysis used to examine the association between the consumption of breakfast and weight change during 10 years of follow-up
- Cox proportional hazards models stratified by five-year age categories and two-year time periods used to calculate the hazard ratio (HR)1 for incidence of 5kg weight gain
- Multivariate models were used to calculate HRs adjusted for age, baseline BMI (kg/m^2), smoking status (never, former, current), marital status (yes/no), work status (full-time, part-time, retired/disabled), physical activity (quintiles of metabolic equivalents tasks), weight training (yes/no) and alcohol intake (0, 0.1 to 4.9, 5.0 to 14.9, 15.0 to 29.9 or 30.0g per day or more)
- Additional adjustments made for percentage of energy from protein, total fat and trans-fat, polyunsaturated fat-to-saturated fat ratio, fiber intake (all in quintiles), consumption of food between breakfast and lunch (yes/no), consumption of food between lunch and dinner (yes/no) and consumption of food after dinner (yes/ no)
- Similar analyses were performed to investigate the association between the frequency of eating occasions and the risk of 5kg weight gain
- The P-values for trend were calculated modeling frequency of eating occasions as a continuous variable
- The P-values for interaction were calculated by comparing models with and without inclusion of cross-product terms for breakfast (yes/no) and BMI (kg/m^2) and for breakfast (yes/no) and age (years) using the log-likelihood test
- Stratified analyses were conducted according to categories of age and BMI
- Associations between breakfast consumption and weight gain were analyzed, while excluding current cigarette smokers in 1992 and 2002 and again excluding men who developed chronic diseases during follow-up
- Sensitivity analysis using 10kg weight gain as the outcome measure
- 95% confidence intervals (CI) for all HRs calculated and all P-values are two-tailed
- Statistical analyses were performed using SAS statistical software (version 9.1; SAS Institute, Inc., Cary, NC).

Data Collection Summary:

Timing of Measurements

- Health Professionals follow-up study began in 1986
- Information on lifestyle factors and health status obtained using biennially mailed questionnaires
- Dietary data assessed every four years
- Dietary data specifically needed for this analysis was added in 1992

- 1992 data is considered the baseline data for this analysis.

Dependent Variable

- Breakfast consumption, assessed via questionnaire item "Please indicate the time of day that you usually eat (before breakfast, breakfast, between breakfast and lunch, lunch, between lunch and dinner, dinner, between dinner and bedtime and after going to bed)," and the semi-quantitative FFQ
- Weight, reported by participants via biennial questionnaire (weight change = difference between 2002 and 1992).

Control Variables

The analysis was adjusted by the following variables:

- Age
- Baseline BMI
- Smoking status
- Work status
- Physical activity
- Weight training
- Alcohol intake
- Percentage of energy from protein, total fat and trans-fat, polyunsaturated fat-to-saturated fat ratio
- Fiber intake
- Consumption of food between meals
- Development of chronic disease during the follow-up time frame.

Description of Actual Data Sample:

- *Initial N:* 51,529 US males in the Health Professional Follow-up Study
- *Attrition (final N):* 20,064 in this sub-analysis
- *Age:* 40 to 75 years
    - Breakfast non-consumers mean age = 53.9 years
    - Breakfast consumers mean age = 58.0 years
- *Other relevant demographics:*
    - Breakfast non-consumers current smoker percentage = 12.7
    - Breakfast consumers current smoker percentage = 4.4
    - Breakfast consumers were younger, lower BMI, more physically active, less likely to be a smoker, more likely to be married, less likely to work full-time
- *Anthropometrics:*
    - Breakfast non-consumers mean BMI = 26.2kg/m^2
    - Breakfast consumers mean BMI = 25.5kg/m^2
- Location: US.

Summary of Results:

- The consumption of breakfast was modestly associated with lower risk of 5kg weight gain during 10 years of follow-up
- This association was more pronounced in men with a baseline BMI of 25kg/m^2 or lower.

Table: Hazard Ratios (HR) of 5kg Weight Gain Among Men According to Breakfast Consumption (95% Confidence Intervals (CIs)

	Breakfast Non-consumers	Breakfast Consumers
All men		
No. of men with 5kg weight gain	1,312	4,345
Person-years	24,678	144,865
≥5kg weight gain per 1,000 person-years	47	31
Age-adjusted HR	1 (referent)	0.77 (0.72 to 0.82)
Multivariate HR	1 (referent)	0.87 (0.82 to 0.93)
Baseline BMI <25kg/m^2		
Age-adjusted HR	1 (referent)	0.70 (0.63 to 0.78)
Multivariate HR	1 (referent)	0.78 (0.70 to 0.87)
Baseline BMI ≥25kg/m^2		
Age-adjusted HR	1 (referent)	0.86 (0.80 to 0.93)
Multivariate HR	1 (referent)	0.92 (0.85 to 1.00)

Other Findings

An increasing number of eating occasions in addition to three standard meals was associated with a higher risk of 5 kg weight gain. The association remained after adjusting for dietary factors.

Author Conclusion:

- Consumption of breakfast may modestly lower the risk of weight gain in middle-aged and older men
- The observation of a stronger association in men who were not overweight at baseline suggests that breakfast consumption may particularly contribute to the prevention of overweight
- An effect of breakfast consumption on reduced weight gain would have important public health implications, and further research in cohort and experimental studies is warranted to verify these findings.

Reviewer Comments:

None.

Research Design and Implementation Criteria Checklist: Primary Research

Relevance Questions		
1.	Would implementing the studied intervention or procedure (if found successful) result in improved outcomes for the patients/clients/population group? (Not Applicable for some epidemiological studies)	Yes
2.	Did the authors study an outcome (dependent variable) or topic that the patients/clients/population group would care about?	Yes
3.	Is the focus of the intervention or procedure (independent variable) or topic of study a common issue of concern to nutrition or dietetics practice?	Yes
4.	Is the intervention or procedure feasible? (NA for some epidemiological studies)	Yes

Validity Questions		
1.	**Was the research question clearly stated?**	Yes
1.1.	Was (were) the specific intervention(s) or procedure(s) [independent variable(s)] identified?	Yes
1.2.	Was (were) the outcome(s) [dependent variable(s)] clearly indicated?	Yes
1.3.	Were the target population and setting specified?	Yes
2.	**Was the selection of study subjects/patients free from bias?**	Yes
2.1.	Were inclusion/exclusion criteria specified (e.g., risk, point in disease progression, diagnostic or prognosis criteria), and with sufficient detail and without omitting criteria critical to the study?	Yes
2.2.	Were criteria applied equally to all study groups?	Yes
2.3.	Were health, demographics, and other characteristics of subjects described?	Yes
2.4.	Were the subjects/patients a representative sample of the relevant population?	Yes
3.	**Were study groups comparable?**	Yes
3.1.	Was the method of assigning subjects/patients to groups described and unbiased? (Method of randomization identified if RCT)	Yes
3.2.	Were distribution of disease status, prognostic factors, and other factors (e.g., demographics) similar across study groups at baseline?	N/A
3.3.	Were concurrent controls used? (Concurrent preferred over historical controls.)	N/A

3.4.	If cohort study or cross-sectional study, were groups comparable on important confounding factors and/or were preexisting differences accounted for by using appropriate adjustments in statistical analysis?	Yes
3.5.	If case control or cross-sectional study, were potential confounding factors comparable for cases and controls? (If case series or trial with subjects serving as own control, this criterion is not applicable. Criterion may not be applicable in some cross-sectional studies.)	N/A
3.6.	If diagnostic test, was there an independent blind comparison with an appropriate reference standard (e.g., "gold standard")?	N/A
4.	**Was method of handling withdrawals described?**	Yes
4.1.	Were follow-up methods described and the same for all groups?	Yes
4.2.	Was the number, characteristics of withdrawals (i.e., dropouts, lost to follow up, attrition rate) and/or response rate (cross-sectional studies) described for each group? (Follow up goal for a strong study is 80%.)	Yes
4.3.	Were all enrolled subjects/patients (in the original sample) accounted for?	No
4.4.	Were reasons for withdrawals similar across groups?	N/A
4.5.	If diagnostic test, was decision to perform reference test not dependent on results of test under study?	N/A
5.	**Was blinding used to prevent introduction of bias?**	Yes
5.1.	In intervention study, were subjects, clinicians/practitioners, and investigators blinded to treatment group, as appropriate?	N/A
5.2.	Were data collectors blinded for outcomes assessment? (If outcome is measured using an objective test, such as a lab value, this criterion is assumed to be met.)	Yes
5.3.	In cohort study or cross-sectional study, were measurements of outcomes and risk factors blinded?	Yes
5.4.	In case control study, was case definition explicit and case ascertainment not influenced by exposure status?	N/A
5.5.	In diagnostic study, were test results blinded to patient history and other test results?	N/A
6.	**Were intervention/therapeutic regimens/exposure factor or procedure and any comparison(s) described in detail? Were interveningfactors described?**	Yes
6.1.	In RCT or other intervention trial, were protocols described for all regimens studied?	N/A
6.2.	In observational study, were interventions, study settings, and clinicians/provider described?	Yes

6.3.	Was the intensity and duration of the intervention or exposure factor sufficient to produce a meaningful effect?	N/A
6.4.	Was the amount of exposure and, if relevant, subject/patient compliance measured?	N/A
6.5.	Were co-interventions (e.g., ancillary treatments, other therapies) described?	N/A
6.6.	Were extra or unplanned treatments described?	N/A
6.7.	Was the information for 6.4, 6.5, and 6.6 assessed the same way for all groups?	N/A
6.8.	In diagnostic study, were details of test administration and replication sufficient?	N/A
7.	**Were outcomes clearly defined and the measurements valid and reliable?**	Yes
7.1.	Were primary and secondary endpoints described and relevant to the question?	Yes
7.2.	Were nutrition measures appropriate to question and outcomes of concern?	Yes
7.3.	Was the period of follow-up long enough for important outcome(s) to occur?	Yes
7.4.	Were the observations and measurements based on standard, valid, and reliable data collection instruments/tests/procedures?	Yes
7.5.	Was the measurement of effect at an appropriate level of precision?	Yes
7.6.	Were other factors accounted for (measured) that could affect outcomes?	Yes
7.7.	Were the measurements conducted consistently across groups?	Yes
8.	**Was the statistical analysis appropriate for the study design and type of outcome indicators?**	Yes
8.1.	Were statistical analyses adequately described and the results reported appropriately?	Yes
8.2.	Were correct statistical tests used and assumptions of test not violated?	Yes
8.3.	Were statistics reported with levels of significance and/or confidence intervals?	Yes
8.4.	Was "intent to treat" analysis of outcomes done (and as appropriate, was there an analysis of outcomes for those maximally exposed or a dose-response analysis)?	N/A
8.5.	Were adequate adjustments made for effects of confounding factors that might have affected the outcomes (e.g., multivariate analyses)?	Yes
8.6.	Was clinical significance as well as statistical significance reported?	Yes

8.7.	If negative findings, was a power calculation reported to address type 2 error?	N/A
9.	**Are conclusions supported by results with biases and limitations taken into consideration?**	Yes
9.1.	Is there a discussion of findings?	Yes
9.2.	Are biases and study limitations identified and discussed?	Yes
10.	**Is bias due to study's funding or sponsorship unlikely?**	Yes
10.1.	Were sources of funding and investigators' affiliations described?	Yes
10.2.	Was the study free from apparent conflict of interest?	Yes